REMARKS

Amendments to the Specification

The amendments to paragraph **[0001]** of the specification insert the serial number of the related case as suggested by the Examiner in paragraph 1 of the Office Action. The amendments to paragraphs **[0057]** and **[0063]** correct a typographical errors in the paragraph.

Amendments to the Claims

Claim 1 is amended to replace the term "surface" with the word "substrate". Support for the amendment is found in paragraph **[0007]**, which notes that a source of contamination is from "wafers . . . that may leech contaminants during the manufacturing and photolithography process." Thus, methods of the invention may remove contaminants that are not just on a surface. Also, Example 5, paragraphs **[0053]** – **[0060]**, describes results of an experiment which decontaminates different types of diaphragm valves. Specifically, paragraph **[0054]** states that "hydrocarbon contamination [is] generated by outgassing from elastomeric components in the valves." Thus, methods of the invention may decontaminate substrates that outgas contaminants, regardless of the physical location of the contaminants. Amendments to Claims 6, 10, and 11 also replace the term "surface" with the word "substrate", support provided as enunciated above.

Claim 1 is also amended to replace the step of "purifying a purge gas" with "providing a purified purge gas." Support for the amendment is present in Examples 1-6 of the application, which utilize various purified purge gases to remove airborne molecular contaminants (AMC) from a substrate without requiring that the actual purification of the purge gases take place as part of the AMC removal method.

Claims 2-4, 6, 7, 10, and 11 are also amended to provide clearer, consistent claim language. Claim 7 is amended to correct a spelling error. The Amendments to Claims 6 and 7 should obviate the rejection thereof under 35 U.S.C. §112, second paragraph. With respect to Claims 10 and 11, support for the amendments may be found in the description of FIG. 5 at paragraph **[0046]**, and the various examples of the application.

Prior Art Rejections

A. Independent Claim 1

Amended Claim 1 is drawn to "[a] method for the removal of airborne molecular contaminants (AMC) from a substrate." Purified purge gas, comprising water at a concentration at least about 100 parts per million (ppm) on a volume basis and having an AMC concentration less than about 1 part per billion (ppb), contacts the substrate. A contaminated purge gas with the AMC is subsequently produced and removed, thus removing the AMC from the substrate.

Claim 1 stands rejected under 35 U.S.C. §103(a) as being obvious in light of a combination of Spiegelman *et al.* (U.S. Patent No. 6,638,341) and Kern (Handbook of Semiconductor Wafer Cleaning, 1993, pp. 88-89); and a combination of Somekh (U.S. Patent No. 6,427,703) and Alvarez Jr. *et al.* (U.S. Patent No. 6,391,090). Neither combination, however, can render Claim 1 obvious because none of the references present the claim elements: a method of removing airborne molecular contaminants (AMC) from a substrate using a purified purging gas that (a) comprises water in a concentration of at least 100 ppm; and (b) has an AMC concentration less than 1 ppb.

1. Cited Art Fails to Teach a Purified Purging Gas Comprising Water in a Concentration of at least 100 ppm

None of the references teaches an element of Claim 1: Use of a purified purge gas comprising water at a concentration of at least 100 ppm in a method of removing AMC from a substrate.

Spiegelman discusses preconditioning a gas purification substrate with a purging gas. The Office Action states, however, that Spiegelman does "not teach the purge gas comprising water" (see item 7 of the Office Action). Thus, the reference does not teach the element of Claim 1.

Kern teaches that water may be a contaminant in gases used in semiconductor processing (see page 88). The Office Action states, however, that "Kern fails to teach the limitations of [former] Claim 5," namely a purified purging gas having water comprising 100 ppm to 2% by volume of the gas (see item 8 of the Office Action). Therefore, Kern does not teach the

limitation of a purge gas comprising water at a concentration of at least 100 ppm in amended Claim 1.

Somekh is drawn to methods and devices for oxidizing carbon contaminants into volatile gases that are subsequently evacuated from a lithography system chamber. Somekh, however, provides no teaching regarding the use of water in a purified purge gas at a concentration of at least 100 ppm.

Alvarez teaches methods of decontaminating a gas for use in photolithography and metrology. Alvarez notes the detrimental impact of contaminated gases in photolithography and metrology applications. Alvarez, however, does not teach a method of removing contaminants from a substrate using a "purified purge gas comprising water at a concentration of at least 100 ppm." Indeed, Alvarez suggests that water is a contaminant to be removed from gases to a level far below what is stated in Claim 1.

Alvarez states that "[t]ypically, the lens gases will have water contamination contents in the range of about 10-100 ppm" (wee column 7, lines 66-67). Alvarez, however, goes on to state that "[t]herefore, the effective removal of water is of the utmost importance" (see column 8, lines 3-4). Alvarez continues that "[a]fter contact with the compositions herein, the decontaminated lens gases will have water contents no greater than about than 1 ppb, and often as low as 50 ppt" (see column 8, lines 4-7).

Therefore, Alvarez actually encourages the use of lens gases having water concentrations much lower than 10-100 ppm, and thus much lower than stated in Claim 1. Even assuming that Alvarez could be used to teach the presence of water in a purge gas used to remove AMC from a contaminated substrate, Alvarez encourages using gases with much lower water concentrations. Indeed, Alvarez specifically counsels against lens gases with water concentrations in the range of 10 – 100 ppm.

This teaching is repeated in the cited art by Kern. Kern generally discusses the problem water presents in gas delivery systems and wafer chamber (see pg. 88). Tables 11 and 12 show the progressive decrease in water content of ultrapure nitrogen with time (see pp. 88 and 89). And Kern states that contaminants levels of species such as water "are expected to continue to be tightened to the parts per trillion (ppt) level" (see pg. 88). Thus, Kern in no way suggests that

gases having water in "a concentration of at least about 100 ppm" should have particular benefits.

In contradistinction, the application teaches that the presence of water can actually increase the rate at which an AMC is removed from a substrate. In one instance, as documented in FIG. 18 of the application, the removal of xylene contaminants is substantially faster when higher concentrations of water are utilized in a purge gas relative to pure nitrogen. Thus, the application provides a surprising and unexpected result relative to the teachings of the prior art (e.g., Kern and Alvarez).

Since none of the references teaches a method of removing AMC from a substrate using a purge gas comprising water at a concentration of at least 100 ppm, no combination of the references can render Claim 1 obvious.

2. *Cited Art Fails to Teach a Purging Gas Having an AMC concentration less than about 1 ppb*

In addition, none of the references teaches the use of a purge gas purified to an airborne molecular contaminants (AMC) concentration less than 1 ppb in a method of removing AMC from a substrate.

Spiegelman is directed to preconditioning a substrate with a purging gas in a particular manner to precondition the substrate for subsequent decontamination of a contaminated gas (see Claim 1 of Spiegelman). Spiegelman, however, provides no statement of what purity a *purging gas* must achieve in order to precondition a substrate. Thus, Spiegelman does not teach a method of removing AMC from a substrate using a purge gas purified to an AMC concentration less than 1 ppb.

The Office Action notes that Spiegelman teaches preconditioning a gas purification substrate such that *the substrate may be used subsequently to decontaminate a contaminated gas* to a level on the order of 1-100 ppt (see Claim 17 of Spiegelman). This provides no suggestion, however, of the AMC concentration of the *purging gas* used to precondition a substrate. Thus, the reference does not teach the AMC concentration in the purified purging gas of Claim 1.

Kern teaches that water may be a contaminant in gases used in semiconductor processing (see page 88). Kern provides no teaching regarding purge gas purity relative to AMC desired to be removed from a substrate.

Somekh is drawn to methods and devices for oxidizing carbon contaminants into volatile gases that are subsequently evacuated from a lithography system chamber. Somekh, like Kern, provides no suggestion whatsoever regarding the AMC concentration in a purge gas used to remove AMC from a substrate, as in Claim 1.

Alvarez teaches methods of decontaminating a gas for use in photolithography and metrology. Alvarez notes the detrimental impact of contaminated gases in photolithography and metrology applications. Thus, the methods of Alvarez may be used to *prevent* the contamination of devices by utilizing purified gases produced by the methods taught therein. Alvarez does not discuss or suggest methods of removing contaminants from substrates that are *already contaminated.*

Alvarez does teach producing gases having a contaminant concentration of not more than 1 ppb for use in preventing substrate contamination. Alvarez, however, provides no teaching of any level of AMC concentration in a purge gas used a method of removing contaminants from a substrate, as set forth in Claim 1.

Since none of the references teaches a method of removing AMC from a substrate using a purge gas having an AMC concentration less than about 1 ppb, no combination of the references can render Claim 1 obvious.

Because none of the references teach all of the elements of Claim 1, the claim is patentable and nonobvious.

B. Dependent Claims 2-4, 10, and 11

Claims 2-4, 10, and 11 ultimately depend from Claim 1. Thus, Claims 2-4, 10, and 11 are also patentable for substantially the same reasons that Claim 1 is patentable. Furthermore, Claim 11 is patentable since none of the cited art teaches a method of removing AMC from a substrate in which the substrate includes a silicon substrate.

C. Dependent Claim 5

Claim 5 depends from Claim 1 and is patentable for same reasons. Furthermore, Claim 5 is patentable since none of the cited art teaches a method of removing airborne molecular contaminants (AMC) from a substrate using a purified purge gas including water comprising 100 ppm to 2% of the purge gas by volume, as set forth by the claim.

D. Dependent Claims 6-7

Claims 6 and 7 depend ultimately from Claim 1. Thus, they are both patentable for essentially the same reasons that Clam 1 is patentable. In particular, Claims 6 and 7 are nonobvious over the combination of Somekh, Alvarez, and Van Schaik *et al.* (U.S. patent no. 6,724,460) regardless of whether Van Schaik teaches purging with an inert gas, because of the patentability of Claim 1.

E. New Claims

New Claims 12-15 are presented for entry into the application.

Claim 12 provides the additional limitation that "the steps of contacting at least a portion of the substrate with the purified purge gas, producing a contaminated purge gas, and removing the contaminated purge gas, thereby removes AMC from the substrate at a faster rate than substituting the purified purge gas with another purge gas consisting essentially of nitrogen gas." Support for the claim is found in FIGS. 16-18, which show multiple instances where use of a purified purge gas comprising water, as used in Claim 12, removes xylene contamination at a faster rate than using a purge gas consisting essentially of nitrogen gas (i.e., ultra high purity nitrogen, see paragraphs **[0063]** – **[0065]** of the application).

Claim 12 is patentable over the cited art because none of the cited art teaches that a purified purge gas comprising water removes AMC from a substrate faster than a purge gas consisting essentially of nitrogen gas.

Claim 13 provides the additional limitation that the substrate is "contaminated with AMC before the substrate is contacted with purified purge gas." Support for the amendment is found in the numerous examples of the application which utilize the apparatus of FIG. 4. In particular, as described in paragraph **[0044]**, "a hydrocarbon mixture [] contaminate[s] the surfaces of a test

device." Subsequently, purge gas "created by system 100 [is] directed to the device under test (DUT) 402. The hydrocarbon concentrations leaving the DUT 402 are introduced into the input 122 of the gas chromatography gas analysis system 120, where the hydrocarbon levels can be measured." Thus, a contaminant species measured by the gas chromatograph can be the same contaminant species that contaminates the substrate before purge gas is introduced, in various examples of the application. Claim 15 is similarly supported.

Claim 13 is patentable because none of the references teaches a method of removing AMC using a purified purge gas comprising water that removes AMC at a faster rate than a purge gas consisting essentially of nitrogen gas. Thus, Claim 15 is also patentable for substantially the same reason. In addition, Claim 13 is patentable, being dependent from patentable Claim 12.

Claim 14 is supported at paragraph **[0046]** and the various examples of the application. The claim is patentable over the cited art for the same reasons that Claim 1 is patentable. In addition, none of the cited art is directed toward removing AMC from wafers.

F. Cancelled Claims 8 and 9

Claims 8 and 9 are cancelled to expedite prosecution of the present application. The cancellation is not an admission by the Applicants regarding the propriety of the Office Action's rejection of such claims. Applicants maintain the right to prosecute such claims at a later time.

G. Double Patenting

Claims 1-11 are provisionally rejected as being unpatentable over Claims 1-19 of copending, related U.S. Patent Application No. 10/683,903 for obviousness-type double patenting. Claim amendments to the current application and the related application separate the claims of each application such that each set is patentably distinct. The current application is drawn to methods of removing AMC that utilize a purified purge gas comprising water. U.S. Patent Application No. 10/683,903 is drawn to methods of removing AMC that utilize oxygen in the purified purge gas. The sets are patentably distinct because (i) each set is novel and unobvious; and (ii) the sets are patentable over one another. That is, the use of water in a purified purge gas does not render obvious the use of oxygen in a purified purge gas. The

applications show that the behavior of the purge gases and the concentrations for optimal use are not necessarily the same.

Thus, Claims 1-11 are patentable over the claims of copending U.S. Patent Application No. 10/683,903.

Information Disclosure Statement

An Information Disclosure Statement (IDS) is being filed concurrently herewith. Entry of the IDS is respectfully requested.

CONCLUSION

In view of the above amendments and remarks, it is believed that all pending claims are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned.

Respectfully submitted,

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Dated: 22 November 2004